

What is claimed is:

- 1           1.    A method for transmitting a signal from a plurality of antennas,  
2    said method comprising the steps of:  
3            receiving a symbol stream at a transmitter;  
4            performing a transform on said input symbol stream to generate a  
5            transform result, said transform result comprising an  $N \times N'$   
6            orthogonal space-time block code, and generating  $N'$  first signals;  
7            non-zero complex weighting, over time, at least one of the  $N'$  first  
8            signals of said transform result to generate at least one second  
9            signal, each of said at least one second signals being phase shifted  
10           relative to the one of the  $N'$  first signals from which it was  
11           generated; and,  
12           transmitting, substantially simultaneously, each of said  $N'$  first  
13           signals of said transform result on one of a first at least one  
14           antenna and, each of said at least one second signals on one of a  
15           second at least one antenna.
- 1           2.    The method of claim 1, wherein said input symbol stream  
2    comprises the symbols  $S_1$ ,  $S_2$  and said space time block code comprises a  $2 \times$   
3    2 space time block code, and said  $N'$  signals comprises the stream of  $(S_1, S_2)$   
4    transmitted at  $t_1$  and  $t_2$ , respectively, and  $(-S_2^*, S_1^*)$  transmitted at  $t_1$  and  $t_2$ ,  
5    respectively.
- 1           3.    The method of claim 1, wherein said input symbol stream  
2    comprises the symbols  $S_1$ ,  $S_2$ , and said space time block comprises a  $2 \times 2$   
3    space time block code, and said  $N'$  signals comprises the streams of  $(S_1, -S_2^*)$   
4    transmitted at  $t_1$  and  $t_2$ , respectively, and  $(S_2, S_1^*)$  transmitted at  $t_1$  and  $t_2$ ,  
5    respectively.
- 1           4.    The method of claim 1, wherein said first at least one antenna and  
2    said second at least one antenna comprises a first plurality of  $N'$  antennas and  
3    a second plurality of  $N'$  antennas, respectively, said input symbol stream

4 comprises a traffic channel symbol stream and wherein said method further  
5 comprises the step of:

6 transmitting each of  $2N'$  common pilot channel signals on a  
7 separate one of said first plurality of  $N'$  antennas or on a separate  
8 one of said second plurality of  $N'$  antennas.

1 5. The method of claim 1, wherein said input symbol stream  
2 comprises a traffic channel stream and said method further comprises the step  
3 of:

4 receiving  $N'$  common pilot channel signals at said transmitter;

5 non-zero complex weighting, over time, each of said  $N'$  common  
6 pilot channel signals to generate  $N'$  non-zero complex weighted  
7 common pilot channel signals;

8 transmitting, substantially simultaneously, each of said  $N'$  common  
9 pilot channel signals on one of said first at least one antenna, and  
10 each of said  $N'$  non-zero complex weighted common pilot channel  
11 signals on one of said second at least one antenna.

1 6. The method of claim 1, wherein said input symbol stream includes  
2 a traffic channel stream, and wherein said method further comprises the step of:

3 inserting each of  $N'$  pilot signals after one of said  $N'$  first signals of  
4 said transform result to generate  $N'$  first signals including inserted  
5 pilot signal;

6 wherein said step of non-zero complex weighting comprises non-  
7 zero complex weighting, over time, each of said  $N'$  first signals  
8 including inserted pilot signal to generate  $N'$  second signals  
9 including inserted pilot signal; and,

10 wherein said step of transmitting comprises transmitting,  
11 substantially simultaneously, each of said  $N'$  first signals including  
12 inserted pilot signal on one of a first at least one antenna, and

13                    each of said N' second signals including inserted pilot signal on  
14                    one of a second at least one antenna.

1                7.    The method of claim 1, wherein said step of non-zero complex  
2                weighting comprises phase shifting at least one of said N' first signals using a  
3                continuous analog phase sweep.

1                8.    The method of claim 1, wherein said step of non-zero complex  
2                weighting comprises phase shifting at least one of said N' first signals a  
3                predetermined hopping sequence.

1                9.    The method of claim 8 wherein hopping weights for said  
2                predetermined hopping sequence are derived from a PSK constellation having  
3                Z states and wherein all states are sampled with the same frequency within a  
4                transmission frame.

1                10.   The method of claim 8 wherein hopping weights for said  
2                predetermined hopping sequence are derived from a PSK constellation having  
3                Z states.

1                11.   The method of claim 1, wherein said space time block code  
2                comprises a  $2 \times 2$  STS block code and said N' first signals comprise the  
3                streams of  $(S1W1 - S2*W2)$  transmitted at  $t1$  and  $(S2W1 + S1*W2)$  transmitted  
4                at  $t1$ , wherein  $W1$  and  $W2$  are each a serial concatenation of at least two Walsh  
5                codes.

1                12.   The method of claim 1, wherein said space time block code  
2                comprises a  $2 \times 2$  STS block code and said N' first signals comprise the  
3                streams of  $(S1W1 + S2W2)$  transmitted at  $t1$  and  $(-S2*W1 + S1*W2)$  )  
4                transmitted at  $t1$ , wherein  $W1$  and  $W2$  are each a serial concatenation of at  
5                least two Walsh codes.

1                13.   An apparatus for transmitting a signal, said transmitter comprising:  
2                an input symbol stream;

a processor for performing a transform on said input symbol stream to generate a transform result, said transform result comprising an  $N' \times N'$  orthogonal space-time block code, and generating  $N'$  first signals;

at least one weighter for, non-zero complex weighting, over time, at least one of the  $N'$  first signals of said transform result to generate at least one second signal, each of said at least one second weighted signals phase shifted relative to the one of the  $N'$  first signals from which it was generated, and;

a transmitter for transmitting, substantially simultaneously, each of said  $N'$  first signals of said transform result on one of a first at least one antenna, and each of said  $N'$  second signals on one of a second at least one antenna.

14. The apparatus of claim 13, wherein said input symbol stream comprises the symbols  $S_1$ ,  $S_2$  and said space time block code comprises a  $2 \times 2$  space time block code, and said  $N'$  first signals comprise the stream of ( $S_1$ ,  $S_2$ ) transmitted at  $t_1$  and  $t_2$ , respectively, and ( $-S_2^*$ ,  $S_1^*$ ) transmitted at  $t_1$  and  $t_2$ , respectively.

15. The apparatus of claim 13, wherein said input symbol stream comprises the symbols  $S_1$ ,  $S_2$  and said space time block code comprises a  $2 \times 2$  space time block code and said  $N'$  first signals comprise the streams of ( $S_1$ ,  $-S_2^*$ ) transmitted at  $t_1$  and  $t_2$ , respectively, and ( $S_2$ ,  $S_1^*$ ) transmitted at  $t_1$  and  $t_2$ , respectively.

16. The method of claim 13, wherein said first at least one antenna and said second at least one antenna comprise a first plurality of  $N'$  antennas and a second plurality of  $N'$  antennas, respectively, said input symbol stream comprises a traffic channel symbol stream and wherein said transmitter further comprises;

at least one input for receiving  $N'$  common pilot channel signals at said transmitter;

8 a weighter, said non-zero complex weighter for non-zero complex  
9 weighting, over time, each of said N' common pilot channel  
10 signals to generate N' non-zero complex weighted common pilot  
11 channel signals; and,

12 wherein said transmitter further transmits each of said N' common  
13 pilot channel signals on a separate one of said first at least one  
14 antenna and each of said N' non-zero complex weighted common  
15 pilot channel signals on a separate one of said second at least  
16 one antenna.

1 17. The apparatus of claim 13, wherein said input symbol stream  
2 includes a traffic channel stream and wherein said apparatus further comprises;

3 a multiplexer for inserting each of N' pilot signals after one of said  
4 N' first signals of said transform result to generate N' first signals  
5 including inserted pilot signal; and,

6 at least one weighter for non-zero complex weighting, over time,  
7 each of said N' signals including inserted pilot signal to generate  
8 N' second signals including inserted pilot signal; and,

9 wherein said transmitter transmits, substantially simultaneously,  
10 each of said N' first signals including inserted pilot signal on one of  
11 a first at least one antenna, and each of said N' second signals  
12 including inserted pilot signal on one of a second at least one  
13 antenna.

1 18. The apparatus of claim 13, wherein said at least one weighter  
2 phase shifts at least one of said N' first signals using a continuous analog phase  
3 sweep.

1 19. The apparatus of claim 13, wherein said at least one weighter  
2 phase shifts at least one of said N' first signals using a predetermined hopping  
3 sequence.

1           20. The apparatus of claim 19, wherein hopping weights for said  
2 predetermined hopping sequence are derived from a PSK constellation by  
3 randomly permuting from the Z possible states for successive slots of the  
4 transmission frame.

1           21. The apparatus of claim 13, wherein said space time block code  
2 comprises a  $2 \times 2$  STS block code and said N' first signals comprise the  
3 streams of  $(S1W1 - S2*W2)$  transmitted at t1 and  $(S2W1 + S1*W2)$  transmitted  
4 at t1, wherein W1 and W2 are each a serial concatenation of at least two Walsh  
5 codes.

1           22. The apparatus of claim 13, wherein said space time block code  
2 comprises a  $2 \times 2$  STS block code and said N' first signals comprise the  
3 streams of  $(S1W1 + S2W2)$  ) transmitted at t1 and  $(-S2*W1 + S1*W2)$  )  
4 transmitted at t1, and wherein W1 and W2 are each a serial concatenation of at  
5 least two Walsh codes.